

INVESTIGATION OF DELAYED RECOMPRESSION TREATMENT FOR LIMITING THE INDUCTION OF DYSBARIC OSTEONECROSIS: SHEEP MODEL OF THE DIVER



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Background:

Decompression studies in the UW Diving Physiology Laboratory have investigated the induction of dysbaric osteonecrosis (DON) using the sheep model of the diver and prolonged compressed air exposures and provocative "dropout" decompressions. Dysbaric osteonecrosis may lead to the joint collapse of disabling secondary osteoarthritis.



Figure 1. Sheep #192 with a flexed limb, the classic sign of limb bends in the decompressed UW sheep. She wears a loose collar.

Materials and Methods:

Twenty-seven adult female sheep (90.5 ± 15.5 SD kg) underwent dry-air chamber exposures at 2.27 atm abs (43 fsw, 12.8 msw) for 24 hours, then rapid or "dropout" decompression at 30 feet/min (0.9 atm/min) to surface followed by air recompression treatment (Modified USN Table 1A) with latencies of 4, 8, 10, or 14 hours before recompression. One month after decompression, sheep were injected with 99mTc-methylene diphosphonate (MDP) for bone scans of radii and tibiae to identify "hot spots" signifying active long-bone DON lesions. Alizarin complexone fluorochrome was injected IV to visualize active DON. After euthanasia, necropsies were used to confirm DON lesions seen in bone scans.

Efficacy of Delayed Recompression Treatment

$$43\text{fsw} = 1.30\text{atm} + 0.97\text{atm} = 2.27\text{atm abs}$$

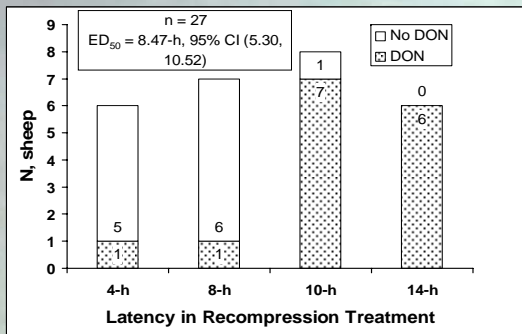


Figure 2. Incidence of DON by latency in recompression treatment.

Results:

Of the 27 sheep that underwent recompression in the 4 treatment groups, 12 sheep sustained DON lesions with active remodeling. Logistic regression showed that DON occurrence was significantly associated with hours of delayed recompression (Wald $p = 0.0146$), and the odds of developing DON were about twice as great for each additional hour of recompression delay (odds ratio = 1.99; 95% CI [1.15, 3.45]). Based on the logistic model, the predicted incidence of DON rose from 4% at 4 hours to 98% at 14 hours, with the DON incidence predicted to be 50% at 8.47 hours of delayed recompression (95% CI [5.30, 10.52]).

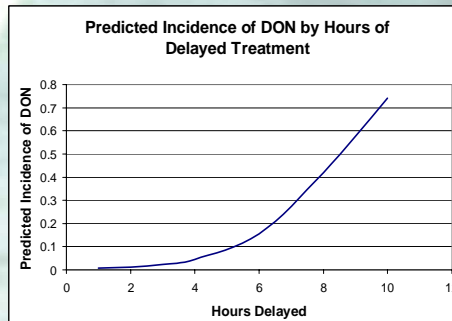


Figure 3. Predicted incidence of DON by latency of recompression treatment. Function based on Figure 2 data.

Discussion and Conclusions:

Delaying recompression treatment of limb bends can markedly elevate the incidence of DON and potentially increase the risk of disabling osteoarthritis in the affected diver.

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